

# Petr Stepanov

Materials science. Particle simulations and data analysis. Software development.

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Ph.D. graduate in physics with expertise **materials science**, **gamma-ray spectroscopy**, **defect studies**, and nuclear physics. 7+ years of experience in **data analysis**, **simulations** in elementary **particle physics** and software development.

## Summary of Qualifications

- More than 7 years of experience in GUI desktop software development for experimental spectra fitting and interpretation (C++, ROOT, Qt, Java, Python).
- Strong materials science skills: defect characterization and porosity studies in bulk materials (with crystal structure and nano-powders).
- Over 5 years of hands-on experience with data acquisition setups and numerous fast electronic modules (ORTEC, Canberra, Tektronix).
- Expertise with particle simulation software. Developed a number of simulation programs for applications in high-energy physics and photonics research.

## Work Experience

### Research Collaborator (On-Site)

[Thomas Jefferson National Laboratory \(JLab\)](https://www.jlab.org), Newport News, VA, USA.

Jul 2020 - Current

- Used Machine Learning (ML) TMVA framework to perform binary classification of thousands of signals from a data acquisition (DAQ) setup. [Link to GitHub](#).
- Applied CERN ROOT framework (C++) to perform statistical analysis of a significant amount (over 100 GB) of the raw experimental data of the [Kaon LT](#) experiment at JLab. [Link to GitHub](#).
- Utilized SLURM environment on [JLab supercomputer environment](#) to run resourceful particle simulations on multiple computing nodes at the same time. This decreased the wall computation time by more than 10 times.
- Proposed and implemented RAMDisk functionality on the development environment. This led to an over 60% increase in source code indexing time.
- Set up data acquisition system that performs triggered waveform acquisition from Tektronix oscilloscope to a local Network Attached Storage (NAS) device. RedHat, Ethernet, SAMBA, Python, National Instruments VISA library.
- Committed 50+ shifts at the particle accelerator performing Target Operator and Shift Leader duties ([Pion LT project](#), experimental Hall C).

### Postdoctoral Researcher (Remote)

[Catholic University of America \(CUA\)](https://www.cua.edu), Washington, DC, USA.

Jul 2020 - Current

- Developed a computer simulation based on the Geant4 framework (C++, CMake, Eclipse IDE, gdb) to study optical properties of a novel scintillation material to be used in the EIC detector system. [Link to GitHub](#).
  - Program accounts on scintillation material properties - composition, transmittance, luminescence.
  - Code reconstructs detector response (PMT or MPPC) depending on the quantum efficiency curve.
  - Visualization of optical photon trajectories with respect to their energy or creator process.
- Teaching experience. Mentoring students within a 3-month Research Experiences for Undergraduates (REU) program at the Physics Department at CUA. Giving talks and presentations about [Linux Terminal](#), and [supercomputer environment](#).
- Enhanced debugging of the core library source code led to opening more than [10 bug reports](#) on the ROOT (C++) forum.

### Research Assistant

[Bowling Green State University \(BGSU\)](https://www.bgsu.edu), Bowling Green, OH, USA.

Aug 2014 - May 2020

- Assembled positron lifetime and Doppler spectrometers from ORTEC and Canberra (Mirion) fast electronic units. Utilized High-Purity Germanium Detectors (HPGe) and scintillation-based detector systems for single-photon counting.
- Developed three open-source programs (C++, CERN ROOT) for novel interpretation of the positron lifetime and Doppler experimental spectra.

- Derived and solved kinetic equations describing formation and chemical of reactions of e<sup>+</sup> and Ps atoms in solids, liquids and nano-powders (Wolfram Mathematica).
- Incorporated physical parameters (grain size, defect concentrations, rate constants) into custom models (PDFs with convolution) for fitting of the experimental spectra (RooFit).
- Above research allowed for estimation of defect concentrations and sizes in solids, classification of defect types (vacancies, dislocations) and characterization of the chemical decoration of defects.
- Wrote a GUI application [LuminApp](#) (Java, Swing) to parse and merge time-stamped data from optical spectrometer and thermometer. This increased data processing time by two orders of magnitude.
- Developed static website (Hexo, Gulp, Bootstrap) and visual identity for the [SelimLab](#) research group. Website has a 99% Google performance rank and features 700 ms time to interactive metrics.

## Computer Science Skills

- **Essentials.** Git, SVN, SSH, Linux, and Terminal usage. BASH scripting. IDEs: Eclipse, Xcode, Visual Studio Code (VS Code).
- **Project management.** JIRA, Trello, GitHub, GitLab.
- **Simulation and data analysis:** Geant4, CERN ROOT, MATLAB, Wolfram Mathematica, Maple.
- **Academic writing:** LaTeX, MS Office Suite, Zotero.
- **Data plotting:** Gnuplot, OriginLab, QtiPlot, SciDaVis, Grapher.
- **Desktop app development.** C/C++, GNU make, CMake. Frameworks: Qt, CERN ROOT, Geant4. Java and Swing. Python.
- **Frontend:** HTML, CSS (LESS and SASS), Bootstrap, responsive web design, JavaScript and jQuery, npm, gulp, AngularJS, React.js. Google Web Toolkit. PHP and WordPress themes development.

## Education

### Bowling Green State University (BGSU) • Ohio, USA

Aug 2014 - May 2020

Ph.D. in Photochemical Sciences • GPA 3.423. Novel developments in positron annihilation spectroscopy techniques—from experimental setups to advanced processing software. [View manuscript](#).

### Ohio Supercomputer Workshop • Ohio, USA

Jan 2017 - Feb 2017

Hands-on sessions in Supercomputer Essentials. Introduction to the key developments in the supercomputer field.

## Featured Publications

- P. S. Stepanov, F. A. Selim et al. Interaction of positronium with dissolved oxygen in liquids. *Physical Chemistry Chemical Physics* **2020**, 22 (9), 5123-5131. [10.1039/c9cp06105c](#).
- P. S. Stepanov, F. A. Selim et al. A model for joint processing of LT and CDB spectra of dielectric nano-sized powders. *AIP Conference Proceedings* **2182** **2019**. [10.1063/1.5135836](#).
- P Saadatkia, P Stepanov et al. Photoconductivity of bulk SrTiO<sub>3</sub> single crystals at room temperature. *Materials Research Express* **2018**, 5 (1), 016202. [10.1088/2053-1591/aaa094](#).
- P.S. Stepanov, S.V. Stepanov et al. Developing New Routine for Processing Two-Dimensional Coincidence Doppler Energy Spectra and Evaluation of Electron Subsystem Properties in Metals. *Acta Physica Polonica A* **2017**, 132 (5), 1628-1633. [10.12693/aphyspola.132.1628](#).
- J. Ji, A. M. Colosimo et al. ZnO Luminescence and scintillation studied via photoexcitation, X-ray excitation and gamma-induced positron spectroscopy. *Scientific Reports* **2016**, 6 (1). [10.1038/srep31238](#).

## Professional Networks

- Discover my professional contacts [on LinkedIn](#) (200+ connections).
- Get familiar with my scientific career [on ResearchGate](#).
- Skim through the list of my publications [on Google Scholar](#) (24 articles, 200+ citations).
- Find examples of my code [on GitHub](#) (50+ repositories).

## Interests

Linux and open-source software. Hosting an [open-source project](#) for keyboard remapping on Linux (300 stars on GitHub).